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QUATERNARY STRATIGRAPHY AND DEPOSITIONAL HISTORY OF GLACIAL LAKE WILLARD, HURON COUNTY, OHIO[1]

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Abstract. Several borings and trenches across the Lake Willard Basin, Huron County, Ohio showed the presence of at least 2 tills and 2 glaciofluvial sequences. The youngest glaciofluvial sequence was overlain by marl and lacustrine silts correlated to classical Lake Willard, which in turn were overlain by organic soils, muck and peat. Wood from the upper part of the marl indicated that the lake possibly began to evaporate or drain as early as 12,500 Y.B.P. (years before present). Silts containing fragments of herbaceous vegetation and finally peat containing a stump and log of *Thuja occidentalis* (northern white cedar) indicated a swamp at 9,810 Y.B.P. Geomorphology and stratigraphy showed that the lake was probably not very deep during all or most of its existence. Fossiliferous marls suggested a very low energy environment after complete retreat of ice from the Willard area.

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Glacial Lake Willard (now Willard Marsh) is located 40 km south of Sandusky and 97 km west of Akron, Ohio (fig. 1). The lake bed lies between the Defiance Moraine and the Fort Wayne-Wabash Moraine in southwestern Huron County (fig. 2). Gently rolling moranic topography surrounds a large flat plain and marks the general boundary of the extinct glacial lake. Organic deposits presently form a slightly crescentic basin approximately 5.6 km long in an east-west direction and 2.5 km wide. The combination of intensive agriculture, uncontrolled fires, and wind erosion has reduced the thickness and expanse of the organic material within the boundaries of the lake bed.

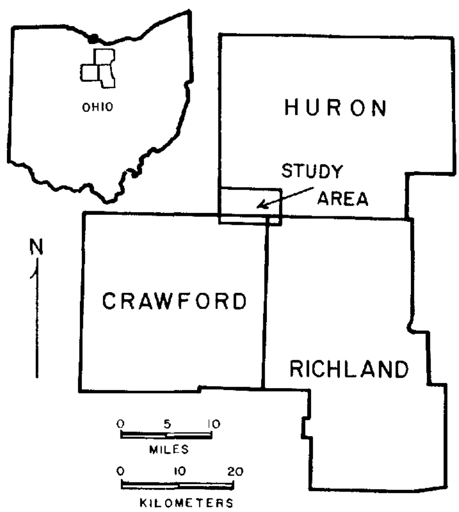

FIGURE 1. Location of study area in North Central Ohio.

Previous Quaternary studies in the area began with Leverett (1902), who described the Defiance Moraine. Dachnowski (1912) studied the extensive peat deposits of New Haven Marsh (now Willard Marsh). Hubbard and Rockwood (1942) concluded that the shorelines of Lake Willard were not tilted. Potter (1946) analyzed pollen from the peat. Campbell (1955) mapped and described the glacial deposits of Erie and Huron Counties. Totten (1973) divided the New Washington Moraine (fig. 2) into 3 elements through the southeast corner of Huron County.

The purpose of this study was to determine the stratigraphy and depositional history of glacial Lake Willard. Two

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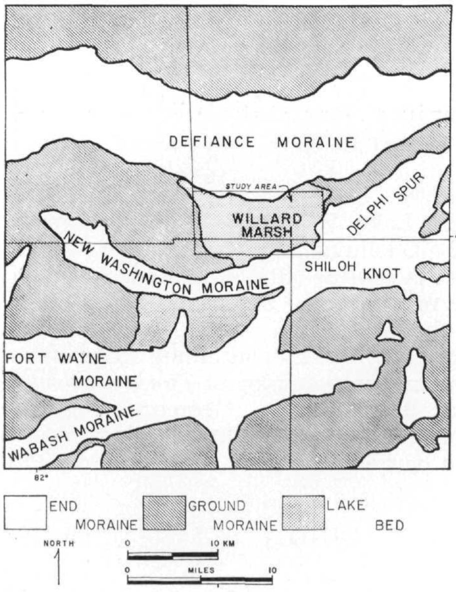

FIGURE 2. Moraines in the vicinity of the study area (after Goldthwait, White, and Forsyth 1961).

cores of sediment were taken from the marsh using Shelby tubes and a hollow-stem auger. One core was 24 m long; the other was 9.2 m long. Ten additional holes were drilled in the eastern half of the basin. In addition, a local farmer dug 4 trenches 4.5 m deep in the eastern part of the marsh. Textural analyses of samples from the borings and trenches helped to determine the stratigraphy in the area. Absolute dates on some deposits were determined by radiocarbon dating of wood samples.

STRATIGRAPHY

Much of the Quaternary stratigraphy of the Willard Marsh area is represented in figure 3, the log of the deep boring on the Handline farm. Five meters of very dark greenish-gray, firm, unleached till were penetrated at the bottom of the boring. Borehole logs showed that the lower till is as much as 11 m thick in some locations. Texturally, the lower till contained equal percentages of sand, silt, and clay (fig. 4). In comparison to the work of Totten (1973) in Richland County to the south, the lower till of the Willard Marsh area seemed to correlate to the Hayesville Till. The lower till had a sand/clay ratio of 1.09 and was sandier than Totten's Hayesville Till, which has a sand/clay ratio of 0.93.

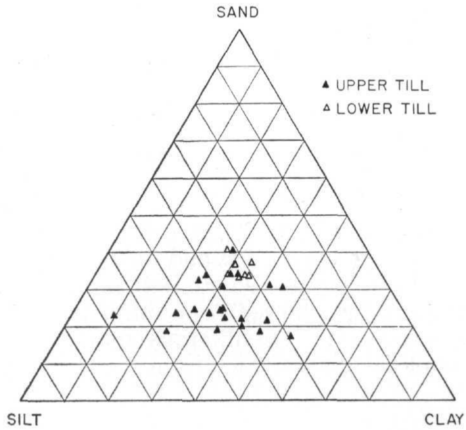

FIGURE 4. Textural analysis of samples of the upper and lower tills.

Above the lower till was a glaciofluvial sequence grading upward from sand and gravel to clayey silt (fig. 3). The gray coarse-grained sand and gravel was interbedded with silt and comprised up to half the sequence. The upper part of the sequence was gray, unleached silt interbedded with fine to medium-grained sand.

Three meters of dark gray, plastic, unleached till was found at a depth of 5 m in the deep borehole (fig. 3). This upper till had a higher silt and clay content than the lower till (fig. 4). The till had a sand/clay ratio of 0.79 and compared closely to Totten's Hiram Till (1973), which has a sand/clay ratio of 0.77.

Other borings in the northern part of the area showed that a thick unit of coarse-grained sand overlaid the upper till and pinched out before the location of the deep boring (Hodges 1979). Dark gray, clayey silt overlaid the sand unit in the nortern part of the area, but in the southern part of the area, the clayey silt immediately overlaid the upper till (Hodges 1979). The borings and trenches delineated a lens-shaped deposit of marl in the southern part of the area. A typical profile of a trench is illustrated in figure 5. A wood fragment, identified as *Thuja occidentalis* (northern white cedar),

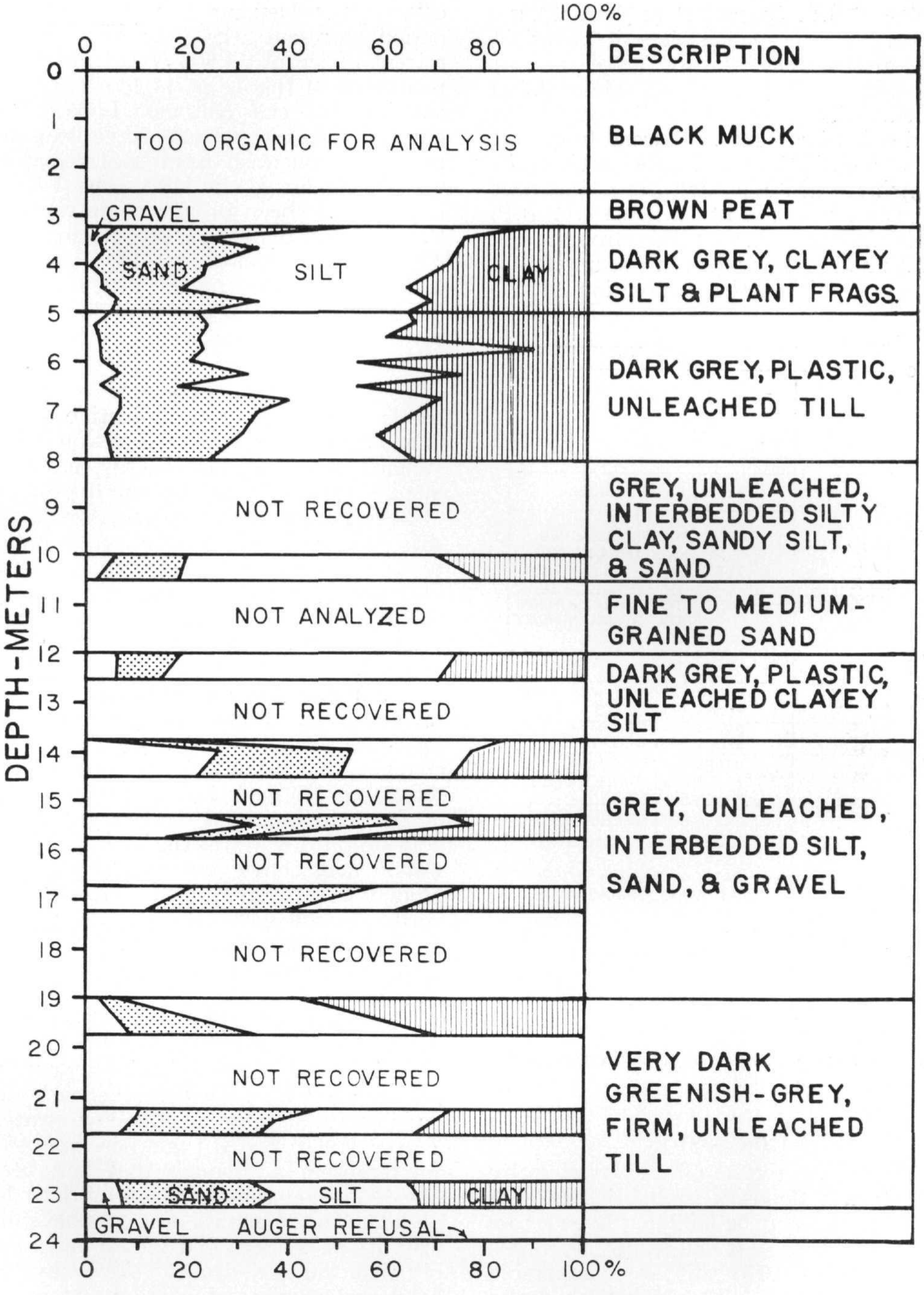

FIGURE 3. Log and textural analysis of the Handline Farm core.

from the marl (fig. 5) was dated at 12,500 ±135 Y.B.P. (years before the present).

Peat and/or muck deposits overlaid the marl or clayey silts. The thickest deposit of peat or muck was about 3.7 m thick. The peat contained many wood and sedge fragments. A wood fragment, also identified as *Thuja occidentalis* (northern white cedar), from the peat (fig. 5) was dated at 9,810±105 Y.B.P. This fragment was taken from a log which had broken off from a stump found in place during the excavation of the trench.

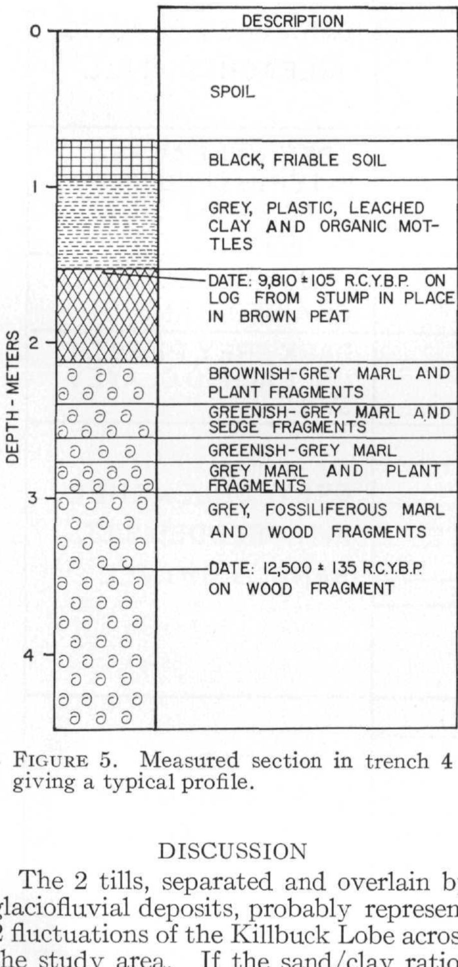

FIGURE 5. Measured section in trench 4 giving a typical profile.

DISCUSSION

The 2 tills, separated and overlain by glaciofluvial deposits, probably represent 2 fluctuations of the Killbuck Lobe across the study area. If the sand/clay ratios of Totten's (1973) tills are comparable to those of the Willard tills, then the glaciofluvial sequence described here would identify time between the Hayesville and Hiram tills and would represent a period described by Mörner (1970) called the Defiance Recession. This period represents the time between the retreat of ice at 14,800 Y.B.P. and the readvance of the ice at 14,400 Y.B.P. in the area of the Killbuck Lobe. The glaciofluvial material may have been deposited as outwash from the retreating ice that deposited the Hayesville Till, or it may have been proglacial outwash of the ice that deposited the Hiram Till. The lack of development of a paleosol and the unleached nature of the glaciofluvial sequence suggest that there was little time for weathering during the fluctuation of the Killbuck Lobe.

The glaciofluvial sequence overlying the Hiram Till may be indicative of the final stages of meltwater deposition in the Willard area. A low energy environment is demonstrated by the deposition of fine-grained sand, lacustrine or fluvial silts, and marl. This situation probably resulted from the formation of the Defiance Moraine and the enclosure of the Willard area to form a basin that could retain meltwater to form Lake Willard.

Water may have entered the basin in several ways. First, embayments in the Defiance Moraine may represent outwash channels that carried meltwater from the retreating Killbuck Lobe. Second, runoff from the moraines to the south probably supplied water to the basin. Third, water may have entered through a groundwater system from outwash deposits to the east. There are several flowing artesian wells in the area that seem to delineate a buried outwash channel.

The deposits in the basin suggest that the lake was most likely very shallow. Thin lacustrine deposits and exposures of till on small knobs within the basis are possible indicators of shallow water. Totten (1969) stated that these knobs of till represent a moraine that had been buried by outwash and lacustrine deposits. The remnants of a possible spillway at the western end of the basin imply that the lake drained slowly by the headward erosion of a tributary to an ice-marginal ancestor of the Sandusky River. Considerable ice blockage at the western end of the basin would have had to occur for the water level of the lake to have been much higher than that of the present marsh. If the water level was much higher, the lake must have had a very short life-span, since no thick lacustrine deposits were observed.

The shoreline of the lake is very difficult to reconstruct because of present agricultural development. The shorelines shown by Hubbard and Rockwood (1942) could not be found by Campbell (1955) or by the authors. The lack of a well-developed shoreline also suggests that the lake was very shallow or very short-lived.

The geometry of the marl deposit implies that by 12,500 Y.B.P., Lake Willard had been reduced to a series of ponds occupying depressions in the basin. The radiocarbon date on the log from the stump in place showed that the small ponds had gradually dried out and been replaced by a marsh by 9,810 Y.B.P. The marsh may have been maintained because of its location in a topographic basin that received runoff from surrounding moraines throughout most of the Recent geologic period.

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